MN : MINING ENGINEERING

Duration : Three Hours *Maximum Marks* :150

Read the following instructions carefully

1. This question paper contains **20** printed pages including pages for rough work. Please check all pages and report discrepancy, if any.

2. Write your registration number, your name and name of the examination centre at the specified locations on the right half of the ORS.

3. Using HB pencil, darken the appropriate bubble under each digit of your registration number and the letters corresponding to your paper code.

4. All the questions in this question paper are of objective type.

5. Questions must be answered on **O**bjective **R**esponse **S**heet (**ORS**) by darkening the appropriate bubble (marked A, B, C, D) using HB pencil against the question number on the left hand side of the ORS. **Each question has only one correct answer**. In case you wish to change an answer, erase the old answer completely. More than one answer bubbled against a question will be treated as a wrong answer.

6. Questions 1 through 20 are 1-mark questions and questions 21 through 85 are 2-mark questions.

7. Questions 71 through 73 is one set of common data questions, questions 74 and 75 is another pair of common data questions. The question pairs (76, 77), (78, 79), (80, 81), (82, 83) and (84, 85) are questions with linked answers. The answer to the second question of the above pairs will depend on the answer to the first question of the pair. If the first question in the linked pair is wrongly answered or is un-attempted, then the answer to the second question in the pair will not be evaluated.

8. Un-attempted questions will carry zero marks.

9. **NEGATIVE MARKING**: For Q.1 to Q.20; ***0.25*** mark will be deducted for each wrong answer. For Q.21 to Q.75, ***0.5*** mark will be deducted for each wrong answer. For the pairs of questions with linked answers, there will be negative marks only for wrong answer to the first question, i.e. for Q.76, Q.78, Q.80, Q.82 and Q.84, ***0.5*** mark will be deducted for each wrong answer. There is no negative marking for Q.77, Q.79, Q.81, Q.83 and Q.85.

10. Calculator **without data connectivity** is allowed in the examination hall.

11. Charts, graph sheets and tables are NOT allowed in the examination hall.

12. Rough work can be done on the question paper itself. Additional blank pages are given at the end of the question paper for rough work.

Q. 1 – Q. 20 carry one mark each.

Q.1 The trace of the following matrix is

$$\begin{pmatrix} 2 & 2 & 3 \\ 3 & 2 & 3 \\ 4 & 1 & 2 \end{pmatrix}$$

(A) 6 (B) 7 (C) 8 (D) 9

Q.2 If X is a continuous random variable and $f(x)$ defines its probability density function, then the expected value of X is

(A) $\int_{-\infty}^{+\infty} f(x)dx$ (B) $\sum_{i=-\infty}^{+\infty} x_i$ (C) $\sum_{i=-\infty}^{+\infty} x_i f(x_i)$ (D) $\int_{-\infty}^{+\infty} xf(x)dx$

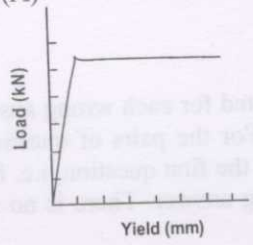
Q.3 The tool used to correct borehole deviation is

(A) String shot (B) Kelly (C) Whipstock (D) Rachet

Q.4 A phreatic surface experiences a pressure

(A) Less than atmospheric pressure
(B) Equal to atmospheric pressure
(C) More than barometric pressure
(D) Less than barometric pressure

Q.5 The load-yield characteristic of a hydraulic prop is represented by the curve

(A)


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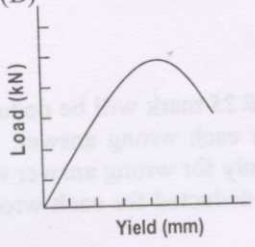

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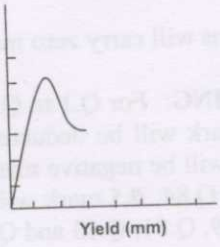

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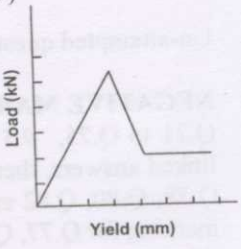


Q.6 In longwall caving, the thickness of immediate roof is calculated from

(A) Bulking factor and width of longwall face
(B) Seam thickness and width of longwall face
(C) Seam thickness and bulking factor
(D) Bulking factor and length of the panel

Q.7 During over-winding, a cage is safely suspended in the headgear due to

(A) Bull chain
(B) Rope capel
(C) D-link
(D) Detaching hook

Q.8 Depending on the decreasing ability of surrounding rock to store strain energy, the underground metal mining methods can be ordered as

(A) Cut-and-Fill stoping, Sublevel caving, Sublevel open stoping, Block caving
(B) Sublevel open stoping, Cut-and-Fill stoping, Sublevel caving, Block caving
(C) Sublevel caving, Sublevel open stoping, Cut-and-Fill stoping, Block caving
(D) Block caving, Sublevel caving, Sublevel open stoping, Cut-and-Fill stoping

Q.9 If swell factor of ore in a shrinkage stope is 1.4, the output from the stope in percent of broken ore is

(A) 0 (B) 29 (C) 40 (D) 100

Q.10 The velocity of the wave type that determines the 'rippability' of rockmass is

(A) P wave (B) S wave (C) Raleigh wave (D) Love wave

Q.11 In the order of the chronological development, the longwall support systems are arranged as

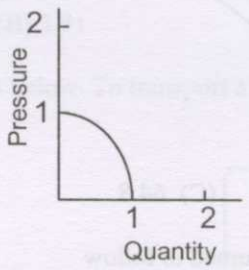
P	Powered support
Q	Link bar and friction support
R	Frame support
S	Hydraulic support

(A) P>Q>R>S (B) R>S>Q>P (C) S>R>P>Q (D) Q>S>R>P

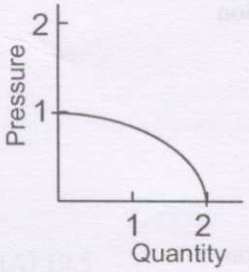
Q.12 Effective temperature is estimated from

(A) Wet-bulb temperature, relative humidity, and air velocity
(B) Dry-bulb temperature, relative humidity, and air velocity
(C) Dry-bulb temperature, wet-bulb temperature, and air velocity
(D) Dry-bulb temperature, wet-bulb temperature, and relative humidity

Q.13 Pressure-quantity characteristic of a mine fan is given below:



The combined characteristic of two such identical fans installed in parallel is

(A)


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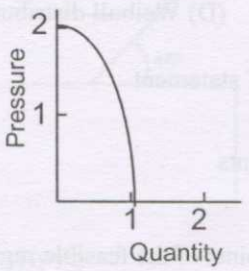

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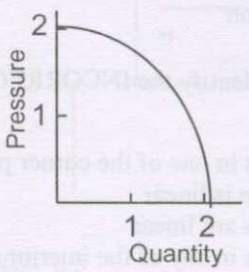
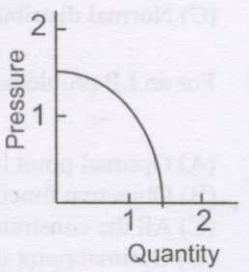


(D)


Q.14 Under identical water head and roadway conditions for water dam construction, if P, Q, and R represent the thickness of flat dam, cylindrical dam and spherical dam respectively, the thickness would follow the order

(A) R>P>Q (B) P>R>Q (C) P>Q>R (D) Q>P>R

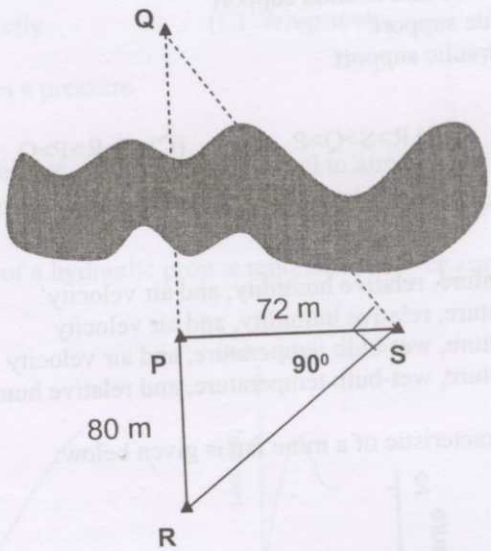
Q.15 The grain size distribution of soil is known as

(A) Permeability (B) Structure (C) Porosity (D) Texture

Q.16 Electrostatic precipitator works on the principle of

(A) Capacitance change
(B) Ionization of the particles
(C) Electro heating of gases
(D) Centrifuging the gaseous molecules

Q.17 In the figure shown below, the distances RP and PS are measured to be 80 m, and 72 m respectively. The distance PQ in m is



(A) 60.4 (B) 66.4 (C) 64.8 (D) 68.4

Q.18 In PERT network, the activity duration is assumed to follow

(A) Beta distribution
(B) Binomial distribution
(C) Normal distribution
(D) Weibull distribution

Q.19 For an LP problem, identify the INCORRECT statement

(A) Optimal point lies in one of the corner points
(B) Objective function is linear
(C) All the constraints are linear
(D) Optimal point lies in any of the interior points of the feasible region

Q.20 In a bi-axial stress field the vertical stress is 10 MPa and the Poisson ratio for the rock mass is 0.2. The horizontal stress in MPa is,

(A) 1.5 (B) 2.5 (C) 2.0 (D) 5.0

Q. 21 to Q.75 carry two marks each.

Q.21 Given bench height: 12m, burden: 4m, spacing: 5m; sub-grade drilling: 2m; explosive per hole: 120 kg; density of rock: 2600 kg /m^3, the powder factor in tonne/kg is

(A) 2.0 (B) 4.6 (C) 5.2 (D) 7.3

Q.22 Match the following:

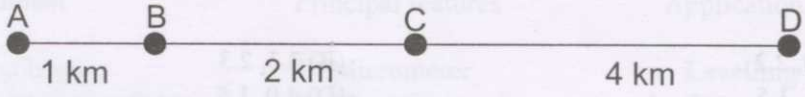
Equipment	Slice thickness (range in m)	Action
P Dragline	1 6 - 12	a Crowding
Q Shovel	2 30 - 40	b Hoisting
R Surface Miner	3 0.2 - 0.4	c Cutting

(A) P-1-b; Q-2-a; R-3-c (B) P-2-b; Q-1-a; R-3-c
(C) P-2-a; Q-1-b; R-3-c (D) P-2-b; R-1-a; Q-3-c

Q.23 If the value of ore is Rs. 600 per tonne, production cost Rs. 400 per tonne, and cost of overburden removal Rs. 50 per m^3, the break-even stripping ratio in m^3/tonne is

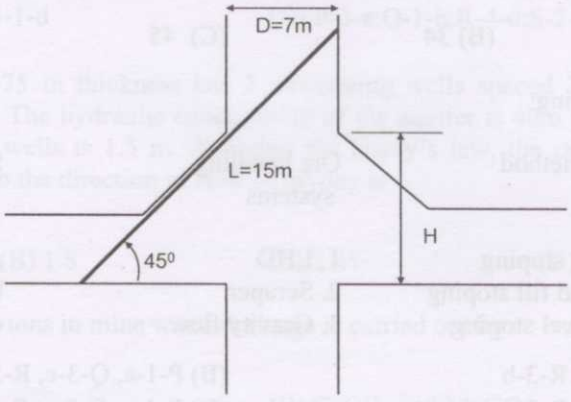
(A) 4:1 (B) 3:1 (C) 1:3 (D) 1:4

Q.24 Four mines A, B, C and D are located along a road as shown with production in Mt per year 1, 2, 1 and 3 respectively. In order to handle total coal produced, the ideal distance of a coal washery along the road from the mine A in km is



(A) 4.01 (B) 3.91 (C) 3.81 (D) 3.71

Q.25 A shaft inset is as shown below. To transport a 15 m long object, the height 'H' of the inset in m should be



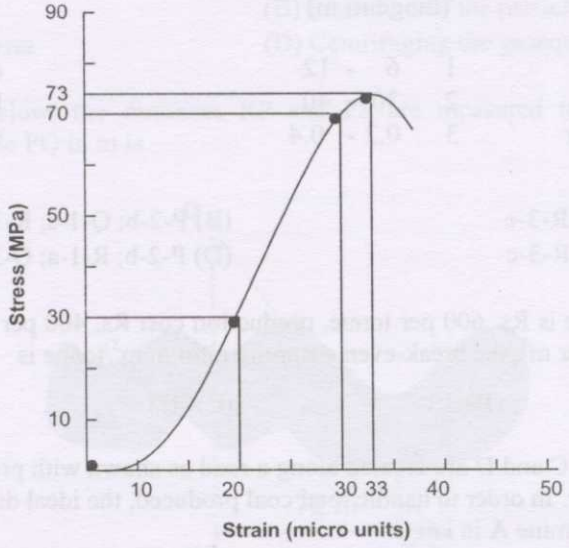
(A) 10.5 (B) 7.0 (C) 6.5 (D) 5.9

Q.26 Match the following:

Blast Problem		Cause	
P	Misfire	1	Poor stemming
Q	Vibration	2	Low current
R	Blown-out shot	3	Excess charge
S	Cut-off shot	4	Improper delays

(A) P-3, Q-2, R-4, S-1
(B) P-4, Q-1, R-2, S-3
(C) P-2, Q-3, R-1, S-4
(D) P-1, Q-2, R-4, S-3

Q.27 From the stress-strain diagram shown below, the tangent and the secant moduli of elasticity in GPa are



(A) 4.0, 2.2
(B) 3.3, 2.3
(C) 3.3, 1.5
(D) 4.0, 1.5

Q.28 A bord and pillar operation is planned at a depth of 300 m in a strata of average unit weight 24.5 kN/m^3 and compressive strength 15.50 MPa. If the width of the opening is 6 m considering a factor of safety of 1, the maximum possible extraction ratio in percentage is

(A) 28 (B) 34 (C) 45 (D) 53

Q.29 Match the following:

Stoping method	Ore handling systems	Support system
P. Breast stoping	1. LHD	a. In situ pillars
Q. Cut and fill stoping	2. Scraper	b. Unsupported
R. Sublevel stoping	3. Gravity flow	c. Mill tailings

(A) P-2-a, Q-1-c, R-3-b
(B) P-1-a, Q-3-c, R-2-b
(C) P-2-b, Q-1-a, R-3-c
(D) P-1-c, Q-3-a, R-2-b

Q.30 Match the following:

Access	Haulage	Mineralisation location
P. Shaft	1. Track	a. Moderate depth
Q.Decline	2. Trackless	b. Deep seated
R. Adit	3. Hoisting	c. Hillock

(A) P-1-a, Q-3-b, R-2-c
(B) P-3-b, Q-2-a, R-1-c
(C) P-2-a, Q-1-b, R-3-c
(D) P-2-b, Q-3-c, R-1-a

Q.31 Match the following:

	Mining method		Operation
P	Bord and Pillar	1	Longhole radial drilling
Q	Sublevel caving	2	Splitting and slicing
R	Longwall retreating	3	Loosening under strata pressure
S	Integrated Caving	4	Mechanical cutting

(A) P-1, Q-4, R-3, S-2
(B) P-2, Q-3, R-1, S-4
(C) P-4, Q-2, R-3, S-1
(D) P-2, Q-1, R-4, S-3

Q.32 A 30m tape has an error of ± 0.005 m. If a length of 1500 m is measured with this tape, the expected total error made in the measurement in m is

(A) ±0.025 (B) ±0.030 (C) ±0.035 (D) ±0.04

Q.33 Match the following:

	Instrument		Principal features		Application
P	Tilting level	1	Micrometer	a	Levelling
Q	Microoptic theodolite	2	Magnetic needle	b	Traversing
R	Telescopic alidade	3	U-tube	c	Azimuth (Bearing)
S	Compass	4	Plane table surveying	d	Contouring

(A) P-1-b;Q-2-c;R-4-a;S-3-d
(B) P-4-b;Q-3-a;R-1-c;S-2-d
(C) P-2-c;Q-3-b;R-4-a;S-1-d
(D) P-3-a;Q-1-b;R-4-d;S-2-c

Q.34 A confined aquifer of 75 m thickness has 2 monitoring wells spaced 2500 m apart along the direction of water flow. The hydraulic conductivity of the aquifer is 40m per day. The water head difference between the wells is 1.5 m. Applying the Darcy's law, the rate of flow per meter of distance perpendicular to the direction of flow in m^3/day is

(A) 2.1 (B) 1.8 (C) 1.45 (D) 1.21

Q.35 Precipitation of metallic ions in mine water drainage is carried out by

(A) $CaSO_4$ and $MgSO_4$
(B) $CaCO_3$ and $MgCO_3$
(C) $Ca(OH)_2$ and NaOH
(D) $CaCO_3$ and $MgSO_4$

Q.36 In a mine, a control chart constructed for fixed carbon has upper and lower limits of 49% and 41% respectively. On a day, the five group average values of fixed carbon are 42%, 43%, 40%, 50% and 49.5%. If the process control rule of the mine is to have not more than 2 out of 5 samples to be out of the control chart, the process on that day is

(A) Above upper and below lower control limits
(B) Above upper control limits
(C) Below lower control limits
(D) Within upper and lower control limits

Q.37 A drum winder of radius 2.5 m draws a power of 308 kW when the maximum rope speed is 7 m/s. The RMS torque in kNm is

(A) 55 (B) 76 (C) 110 (D) 144

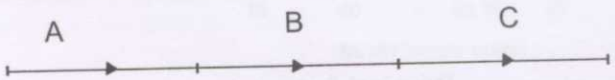
Q.38 A belt conveyor conveys material of average cross-sectional area of 0.09 m^2, of bulk density 1.5 tonne/m^3, at a speed 2 m/s. The carrying capacity of the belt in tonne/hr is

(A) 972 (B) 864 (C) 732 (D) 643

Q.39 The wt % of solids in a sand-water stowing pipe is 60. If the solids density is 3000 kg/m^3, the pulp density of the slurry in kg/m^3 is

(A)1380 (B) 1420 (C) 1560 (D) 1670

Q.40 A mining project comprising of A, B, and C activities is scheduled for 90 days at a cost of Rs.1200 million. The manager of the project decides to reduce the time for completion of the project to 85 days. The decision was taken after 45 days.



Activity	A	B	C
Duration(days)	40	15	35
Crashing cost/day (million rupees)	15	25	20

The minimum project cost in million rupees after crashing by 5 days is

(A) 1100 (B) 1300 (C) 1475 (D) 1825

Q.41 The following information is provided for an ore deposit:

Number of waste blocks	= 10
Number of ore blocks	= 5
Volume of each waste block, m^3	= 600
Total cost of waste handling per m^3	= Rs. 100
Tonnage of each ore block	= 400
Total cost of ore handling per ton	= Rs. 150
Sale price of ore per ton	= Rs. 500

The net cash flow of mining the deposit in lakhs of rupees, is

(A) 3.4 (B) 2.5 (C) 1.0 (D) 0.8

Q.42 Determine the correctness or otherwise of the following **Assertion [a]** and the **Reason [r]**

Assertion: While stonedust barrier may be effective against a coal dust explosion, the same is not true in case of firedamp explosions.

Reason: In general firedamp explosions are much more powerful than coal dust explosions.

(A) Both [a] and [r] are false
(B) [a] is true but [r] is false
(C) Both [a] and [r] are true and [r] is the correct reason for [a]
(D) Both [a] and [r] are true but [r] is not the correct reason for [a]

Q.43 Match the following:

Component of flame safety lamp		Purpose of component	
P	Asbestos rings	1	Dissipation of heat of flue gas
Q	Wire gauges	2	Formation of air-tight joints
R	Outer glass	3	Arrest of explosion inside the lamp
S	Combustion chimney	4	Separation of inlet air from flue gas

(A) P-2, Q-1, R-3, S-4
(B) P-4, Q-1, R-2, S-3
(C) P-2, Q-4, R-3, S-1
(D) P-1, Q-2, R-4, S-3

Q.44 A roadheader district produces 20 mg/ m^3 of airborne dust with the following size distribution:

Size up to	Cumulative wt %
1 μm	1
5 μm	5
10 μm	10
20 μm	20
50 μm	50
> 50 μm	100

The concentration of respirable fraction of dust in mg/m^3 is

(A) 0.2 (B) 2.0 (C) 10.0 (D) 1.0

Q.45 For a person working in an atmosphere containing 21% O_2, the exhaled air contains 4.5% CO_2 and 16% O_2. The respiratory quotient of breathing is

(A) 0.21 (B) 0.9 (C) 0.28 (D) 1.11

Q.46 Total number of injuries in an opencast coal mine employing 800 persons is 16 in a year. As per DGMS norms, the injury rate per 1000 persons employed is

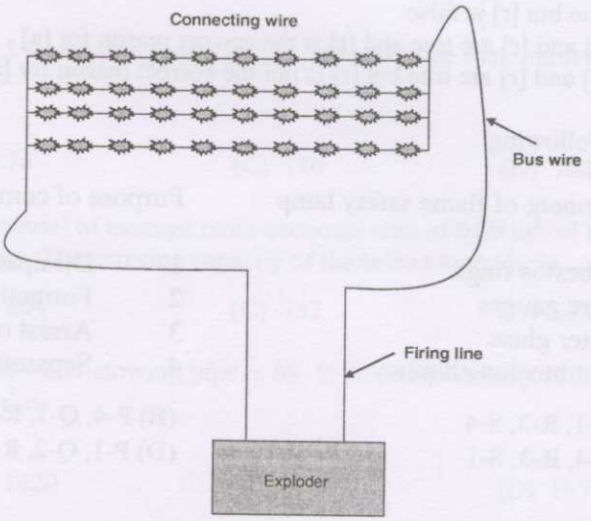
(A) 13 (B) 15 (C) 20 (D) 25

Q.47 The coefficient of friction between the tub-wheel and haulage track is $1/\sqrt{3}$. For the applicability of direct haulage, minimum inclination (in degrees) of track is

(A) 60 (B) 55 (C) 35 (D) 30

Q.48 A surface mine blast pattern shown below has the following details:

Accessory	Resistance (in Ohms)	Number or Length
Detonator	2 per detonator	40 nos
Connecting wire	0.5/m	100 m
Bus wire	0.5/m	100 m
Firing line	0.01/m	200 m



If the exploder supplies 440 V, the current in the blasting circuit in ampere is

(A) 5.36 (B) 3.51 (C) 4.83 (D) 2.57

Q.49 In a surface mine blast, the peak particle velocity (V in mm/s) is estimated from the equation $V = 120(\sqrt{SD})^{-1.0}$, where SD is square root scaled distance. If at a distance of 100 m from the blast site the permissible peak particle velocity is 25 mm/s, the maximum charge per delay in kg is

(A) 404 (B) 414 (C) 434 (D) 464

Q.50 Daily production measured for a period of 50 days in a coal mine exhibits normal distribution with mean 1200 tpd and standard deviation 100 tpd. The 95% confidence interval of daily production (standard normal variable Z at 0.025 level of significance is 1.96) in tpd is

(A) 1200 ± 120.5 (B) 1200 ± 96.0 (C) 1200 ± 39.6 (D) 1200 ± 27.7

Q.51 In an iron ore deposit alumina is distributed with $\mu = 3$ % and $\sigma = 0.5\%$; whereas silica is distributed with $\mu = 2.5$ % and $\sigma = 0.8\%$. The combined alumina and silica (as impurities) has μ and σ, in percentage respectively as

(A) (5.5, 0.94) (B) (5.5, 1.3) (C) (0.5, 0.3) (D) (5.5, 0.62)

Q.52 The inverse of the following matrix is:

$$\begin{pmatrix} 4 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

(A) $\begin{pmatrix} 16 & 0 & 0 \\ 0 & 4 & 0 \\ 0 & 0 & 1 \end{pmatrix}$ (B) $\begin{pmatrix} 0.25 & 0 & 0 \\ 0 & 0.50 & 0 \\ 0 & 0 & 1.00 \end{pmatrix}$

(C) $\begin{pmatrix} 2 & 0 & 0 \\ 0 & \sqrt{2} & 0 \\ 0 & 0 & 1 \end{pmatrix}$ (D) $\begin{pmatrix} 16 & 0 & 0 \\ 0 & 4 & 1 \\ 0 & 0 & 1 \end{pmatrix}$

Q.53 The solution of the following system of linear equations is

$x+4y+3z=0$
$3x+5y+2z=0$
$8x+10y+12z=0$

(A) (0,0,0) (B) (1,-1,1) (C) (2, -1, -2) (D) (-3,0,1)

Q.54 The volume of a cone is given by

$$V = \frac{\pi}{3}\ell^3 \sin^2\theta\cos\theta$$

where, ℓ is the slant height and θ is the semi-vertical angle. The angle (θ), for which the volume of cone becomes maximum is

(A) $\sin^{-1}(\frac{1}{\sqrt{3}})$ (B) $\cos^{-1}(\frac{1}{\sqrt{3}})$

(C) $\cos^{-1}(\sqrt{2})$ (D) $\sin^{-1}(\sqrt{2})$

Q.55 The direction of gradient vector at a point (1, 1, 2) on a surface $S(x, y, z) = x^2+y^2 - z$ is

(A) $\frac{1}{3}(2\mathbf{i} +2\mathbf{j} +\mathbf{k})$ (B) $\frac{1}{3}(-2\mathbf{i} +2\mathbf{j} +\mathbf{k})$

(C) $\frac{1}{3}(2\mathbf{i} -2\mathbf{j} +\mathbf{k})$ (D) $\frac{1}{3}(2\mathbf{i} +2\mathbf{j} -\mathbf{k})$

Q.56 The solution of the differential equation

$$\frac{d^2y}{dx^2}+3\frac{dy}{dx}-4y=0, \text{ is}$$

(A) $y = c_1e^{4x}$ (B) $y = c_1e^{2x}$

(C) $y = c_1e^{x} + c_2e^{-4x}$ (D) $y = c_1e^{-x} + c_2e^{4x}$

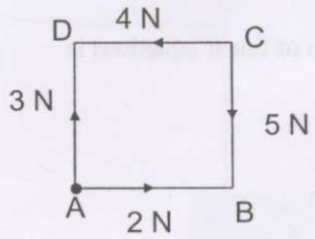
Q.57 A force vector $\mathbf{F} = (2\mathbf{i}+3\mathbf{j}-\mathbf{k})$ in N is acting on a point, whose position vector $\mathbf{r} = (\mathbf{i}-\mathbf{j}+6\mathbf{k})$ in m. The magnitude of the torque about the origin in Nm is

(A) 20.85 (B) 21.42 (C) 21.97 (D) 22.27

Q.58 If H is the maximum height attained by a projectile, the maximum horizontal range when fired at 45^0 inclination from ground level is

(A) 4.0H (B) 3.6H (C) 3.2H (D) 2.7H

Q.59 Force diagram for a square frame is shown below. Considering clockwise moment as positive, the resultant moment about an axis passing through the point A in Nm is



(A) 8 (B) 5 (C) 3 (D) -2

Q.60 The local mean time at longitude $75^0 30^1$ is 8hr 45min. The corresponding standard time with reference to $82^0\ 30^1$ meridian is

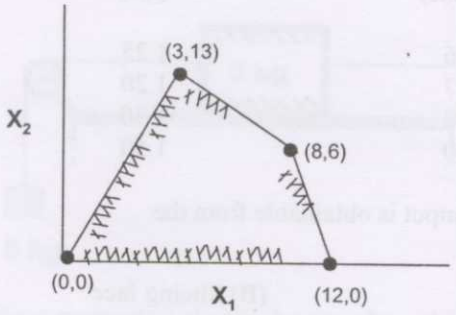
(A) 8 hr 13 min (B) 9 hr 13 min (C) 9 hr 17 min (D) 10 hr 17 min

Q.61 Block economic values in a 2D block model are shown below. Then based on the assumption of 1:1 slope angle, the blocks (identified by row and column numbers) that constitute the ultimate pit are

	1	2	3	4
1	-1	-1	1	-1
2	-1	1	3	-1
3	-1	-1	-1	-1

(A) (1,1), (1,2), (1,3), (2,2) (B) (1,2), (1,3), (1,4), (2,3)
(C) (1,3), (2,4) (D) (1,3), (1,4), (2,4)

Q.62 The feasible region of an LP problem is shown as given below. The maximum value of the objective function $Z = 1600x_1 + 1200x_2$, is



(A) 20400 (B) 20000
(C) 19200 (D) 16800

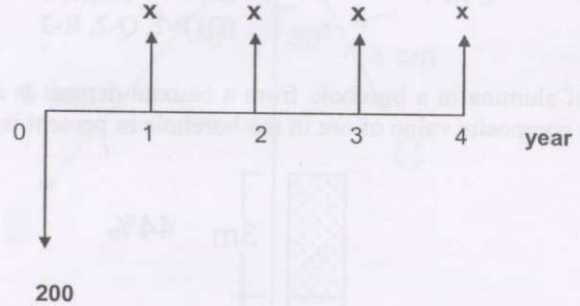
Q.63 A conveyor of rated power 100 kW hauls coal up-dip at 30 kg/s along an inclination of 15^0 and distance 300m. Heat added by the conveyor to the air in kW is

(A) 56.4 (B) 65.9 (C) 77.2 (D) 82.3

Q.64 A cage of floor area 5.0 m^2 suspended in a shaft has a drag coefficient 2.5. If the velocity of air in the shaft is 6.0 m/s, the drag force (N) experienced by the cage is

(A) 120 (B) 170 (C) 200 (D) 270

Q.65 A cash flow diagram is shown below. Based on NPV, at 10 % rate of interest, the minimum annuity 'x' at which the investment becomes viable is



(A) 63 (B) 54 (C) 42 (D) 35

Q.66 A system of two identical mine pumps connected in series has reliability 0.49. If the pumps were to be connected in parallel, the system reliability would be

(A) 0.21 (B) 0.6 (C) 0.91 (D) 0.95

Q.67 An SDL working at different faces gives the following performance:

Operating Face	Production per blast (tonne)	Muck clearance time (hrs)
Development face	16	1.25
Splitting face	17	1.20
Slicing face	18	1.30
Heightening face	20	1.50

In 5 hrs operation maximum output is obtainable from the

(A) Heightening face (B) Slicing face
(C) Development face (D) Splitting face

Q.68 In a coal handling plant wagons of 8m length are loaded, at rake travel speed of 0.48 km/hr. The chute loading rate is 6000 tonne/hr. As the rake moves continuously, the chute stops for a total of 24s in between two wagons. The quantity of coal in tonne loaded in each wagon is

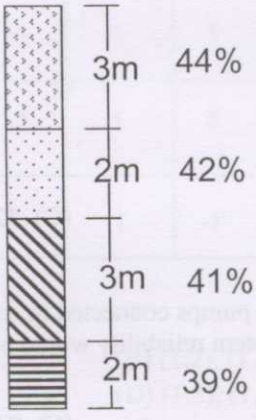
(A) 52 (B) 60 (C) 76 (D) 94

Q.69 Match the following:

Failure criteria		Relationship
P.	Drucker- Prager	1. $\sigma_1 = \sigma_3 + \sqrt{m\sigma_3 + s^2}$
Q.	Hoek – Brown	2. $\tau = c + \sigma_n \tan\phi$
R.	Mohr – Coulomb	3. $\sqrt{2/3}\left[\left(\frac{\sigma_1-\sigma_2}{2}\right)^2+\left(\frac{\sigma_2-\sigma_3}{2}\right)^2+\left(\frac{\sigma_3-\sigma_1}{2}\right)^2\right]^{1/2} = A(\sigma_1+\sigma_2+\sigma_3)+B$

(A) P-1, Q-3, R-2 (B) P-3, Q-1, R-2
(C) P-3, Q-2, R-1 (D) P-1, Q-2, R-3

Q.70 An assay value of alumina in a borehole from a bauxite deposit is as shown below. If the cut-off grade is 40%, the composite value of ore in the borehole in percent is



(A) 31.6 (B) 33.9 (C) 41.7 (D) 42.2

Common Data Questions

Common Data for Questions 71, 72 and 73: Two blocks of mass 5 kg and 10 kg are connected with cords and frictionless pulleys as shown. Friction coefficient between the 5 kg block and table is 0.2.

Q.71 The acceleration of the system when the blocks are released from rest ('g' is acceleration due to gravity) is

(A) 5g (B) 2g (C) g/5 (D) g/10

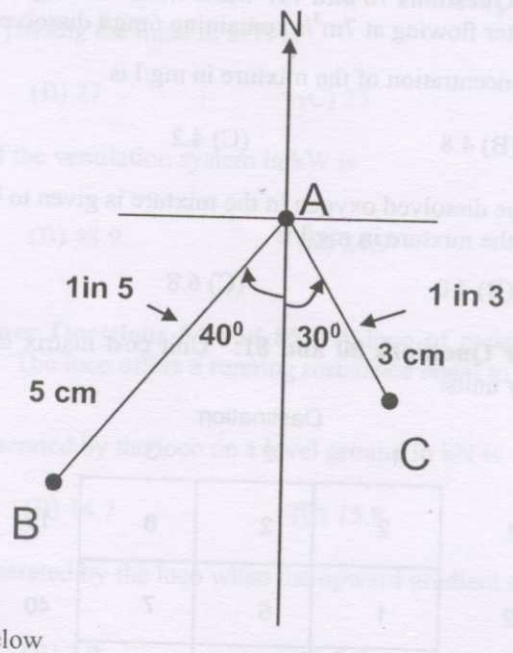
Q.72 Tension (N) in the cord connected to the10 kg block is

(A) 8g (B) 6g (C) 4g (D) 2g

Q.73 Tension (N) in the cord connected to the 5 kg block is

(A) 8g (B) 6g (C) 4g (D) 2g

Common Data for Questions 74 and 75: Three boreholes intersect a coal seam at points A, B and C as shown. (figure is drawn to scale):



The survey details are given below

Line	Bearing	Gradient
AB	S 40°W	1 in 5
AC	S 30°E	1 in 3

Q.74 The direction of true dip of the seam is

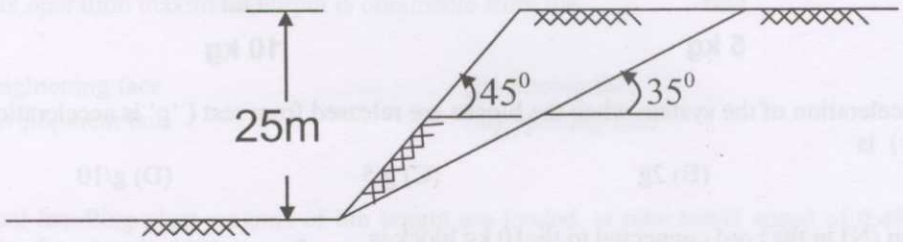
(A) S 15° W (B) S 25° W (C) S 15° E (D) S 30° E

Q.75 The gradient of the seam is

(A) 1 in 2.7 (B) 1 in 3.7 (C) 1 in 4.7 (D) 1 in 5.7

Linked Answer Questions: Q.76 to Q.85 carry two marks each.

Statement for Linked Answer Questions 76 and 77: An open pit mine bench has a potential failure plane as indicated below. The unit weight, cohesion, and angle of internal friction of the rock mass are 24.5kN/m^3, 0.02 MPa and 30^0 respectively.



Q.76 The driving force for failure, on the potential failure plane is

(A) 187 N (B) 1.87 kN (C) 18.7 kN (D) 1.87 MN

Q.77 The 'factor of safety' of slope under given conditions is

(A) 0.7 (B) 0.9 (C) 1.1 (D) 1.3

Statement for Linked Answer Questions 78 and 79: Mine water flowing at 1.5m^3/s with 2 mg/l dissolved oxygen, joins river water flowing at 7m^3/s containing 6mg/l dissolved oxygen.

Q.78 The dissolved oxygen concentration of the mixture in mg/l is

(A) 5.3 (B) 4.8 (C) 4.2 (D) 3.9

Q.79 The saturated value of the dissolved oxygen in the mixture is given to be 9.3mg/l. On this basis, the initial oxygen deficit of the mixture in mg/l is

(A) 2.4 (B) 4.0 (C) 6.8 (D) 14.6

Statement for Linked Answer Questions 80 and 81: Unit cost matrix of a transportation problem is given below in certain monetary units.

		Destination 1	2	3	
Source	1	2	2	8	15
	2	1	5	7	40
	3	6	4	3	20
		10	25	40	

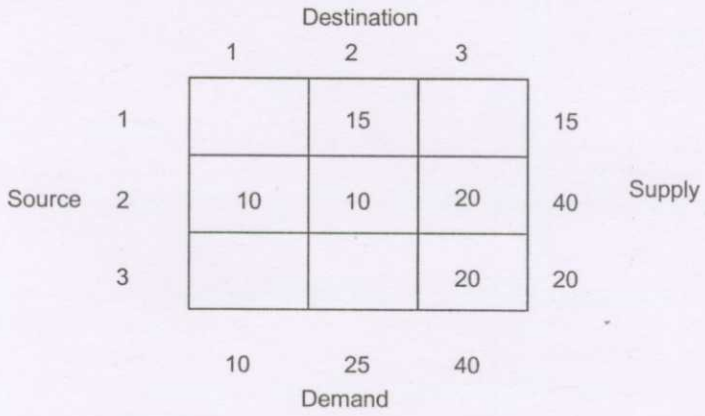
Supply

Demand

Q.80 The total cost of transportation based on the initial basic feasible solution obtained by the North-West corner rule is

(A) 250 (B) 290 (C) 330 (D) 360

Q.81 The optimal solution for the transportation problem has allocation as shown below:



When compared to initial basic feasible solution from the above, the optimal allocation results in savings of

(A) 10 (B) 20 (C) 30 (D) 40

Statement for Linked Answer Questions 82 and 83: In a mine ventilation system, the resistances of two splits A and B are 0.5 Ns^2m^{-8} and 2.0 Ns^2m^{-8} respectively. Combined resistance of two shafts and trunk airways is 0.7 Ns^2m^{-8}. A quantity of 20 m^3/s of air passes through split A.

Q.82 The total air quantity passing the mine in m^3/s is

(A) 30 (B) 27 (C) 25 (D) 17

Q.83 The total air power of the ventilation system in kW is

(A) 82.9 (B) 48.9 (C) 24.9 (D) 27.9

Statement for Linked Answer Questions 84 and 85: A loco of mass 10000 kg has a coefficient of adhesion to the tracks as 0.25. The loco offers a running resistance equal to 10% of its weight.

Q.84 The draw-bar-pull generated by the loco on a level ground in kN is

(A) 11.3 (B) 14.7 (C) 15.8 (D) 17.2

Q.85 The draw-bar-pull generated by the loco when the upward gradient of the track is 5^0 in kN is

(A) 6.16 (B) 7.9 (C) 9.5 (D) 11.5

END OF THE QUESTION PAPER